

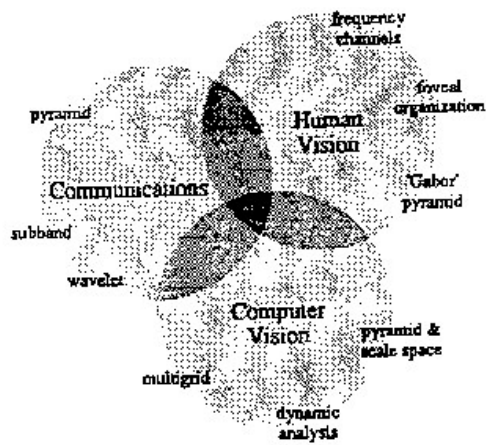
Multiresolution Methods for "Intelligent,"  
Motion Adaptive, Image Compression

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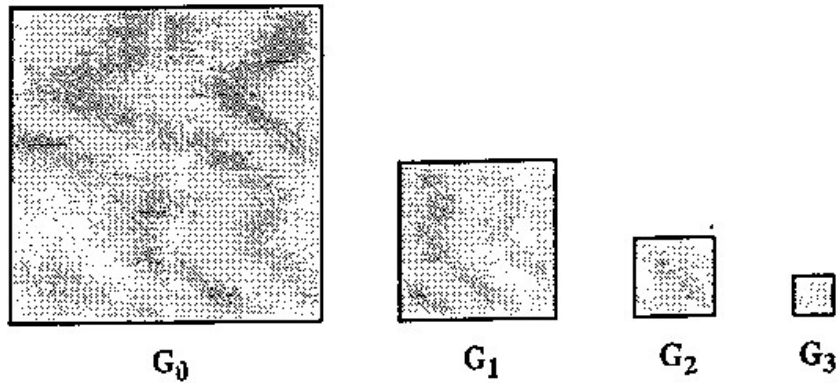
Jim Bergen  
Steve Hsu  
Ray Kolczynski  
Shmuel Peleg

Raj Hingorani  
Matt Clark  
Gooitzen van der Wal  
Ron Sverdlove



Multiresolution technology in three image related fields.

## The Pyramid Structure



### The pyramid is ...

- a sequence of low or band pass images, subsampled

### It provides ...

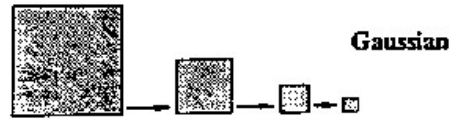
- a match to information scale
- fast, coarse-to-fine algorithms
- fast, fine-to-coarse feature computations

### At the same time ...

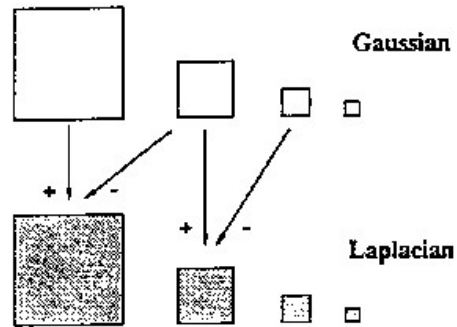
- a complete image representation
- match to human vision
- practical hardware

# Three pyramid types

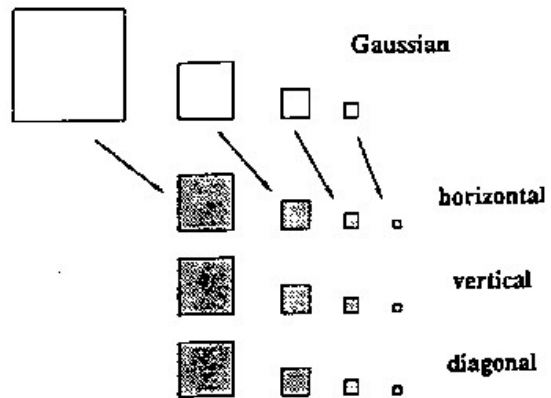
**Gaussian Pyramid**  
(low pass)

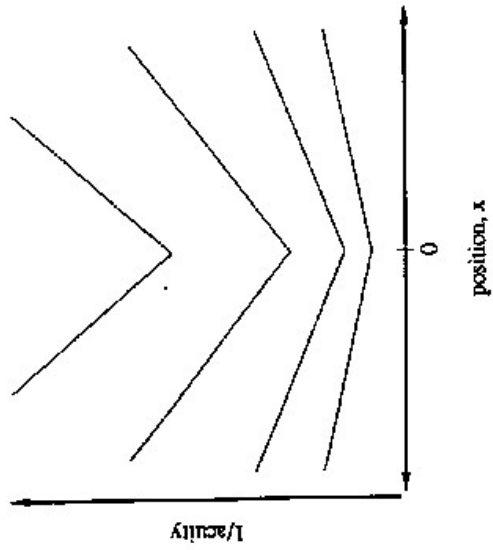


**Laplacian Pyramid**  
(band pass)

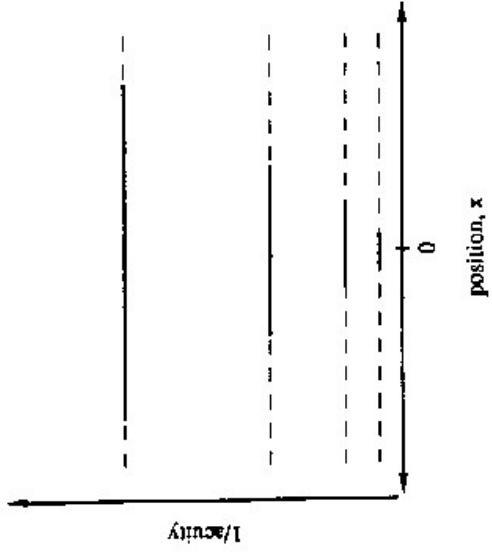


**QMF Pyramid**  
(oriented)

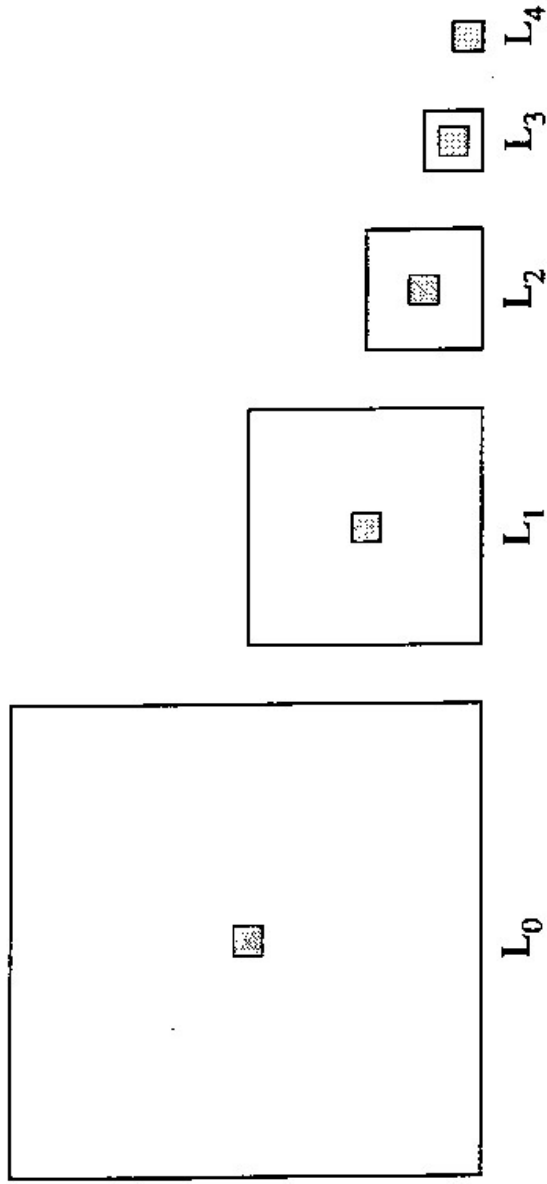




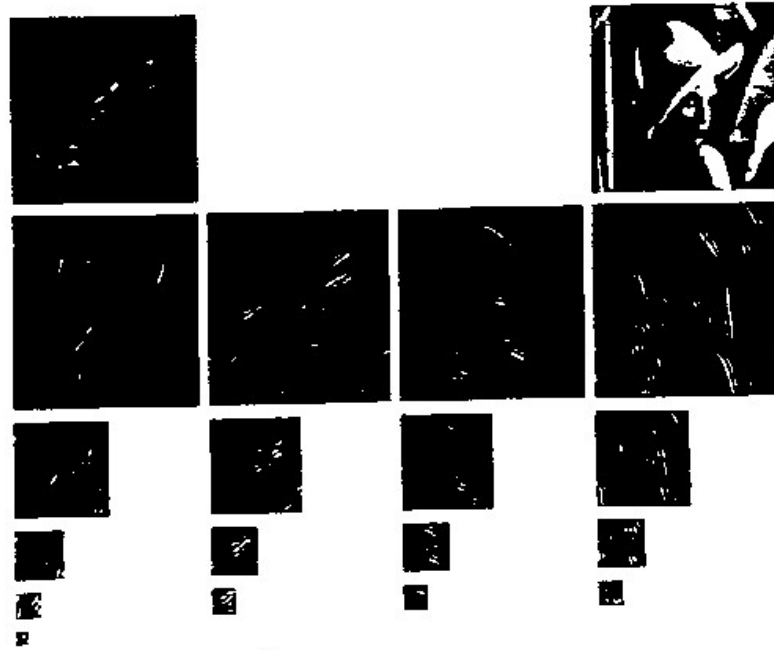
Wilson-Bergen four channel model.  
(Vision Research, 1979)



Laplacian pyramid fovea.

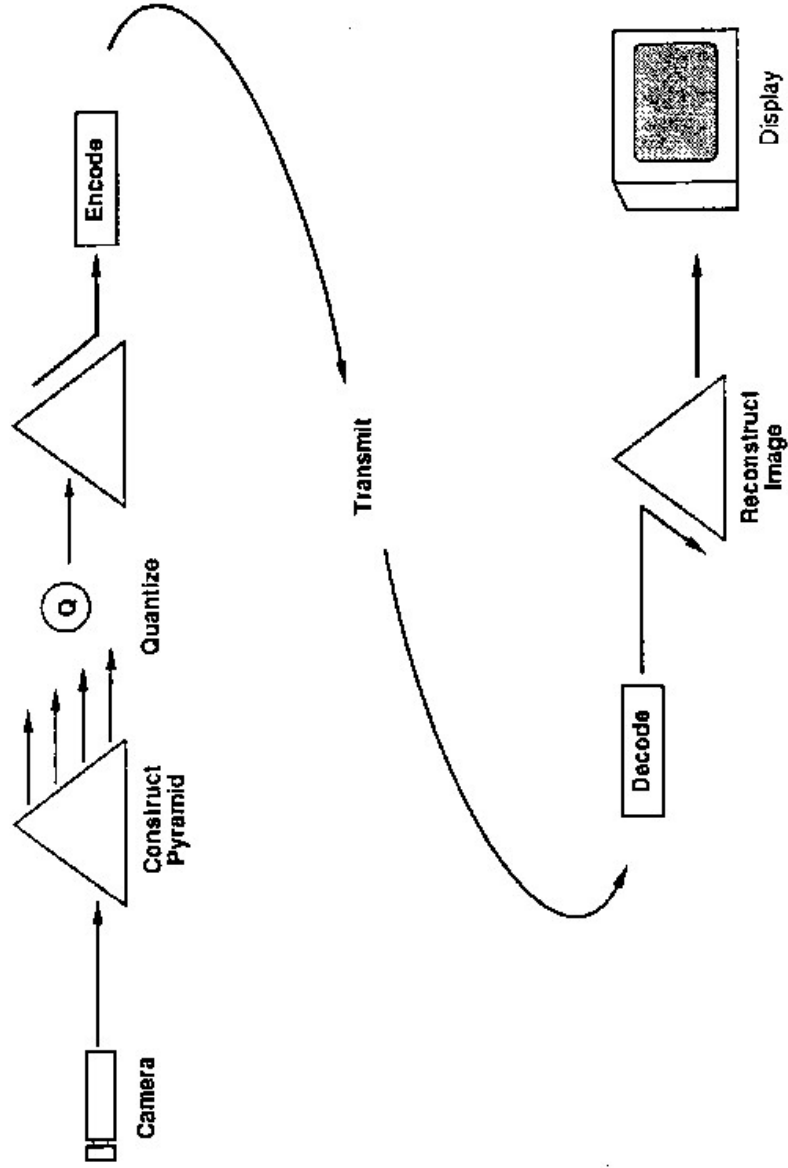


Laplacian pyramid fovea.



**Watson's Cortex transform.**  
(J. Opt. Soc. Am., 1987)

# Progressive Transmission



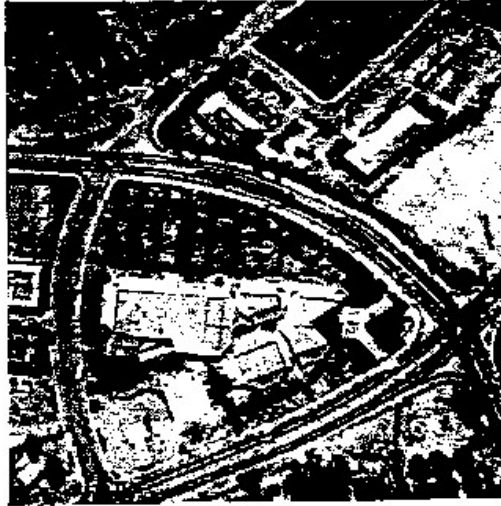


## QMF Features: Progressive Image Transmission



**Objective:** Send still images over low bandwidth lines quickly using small, compact hardware. The "progressive" image transmission format provides a fast, responsive system.

## QMF Features: Smart Data Transmission

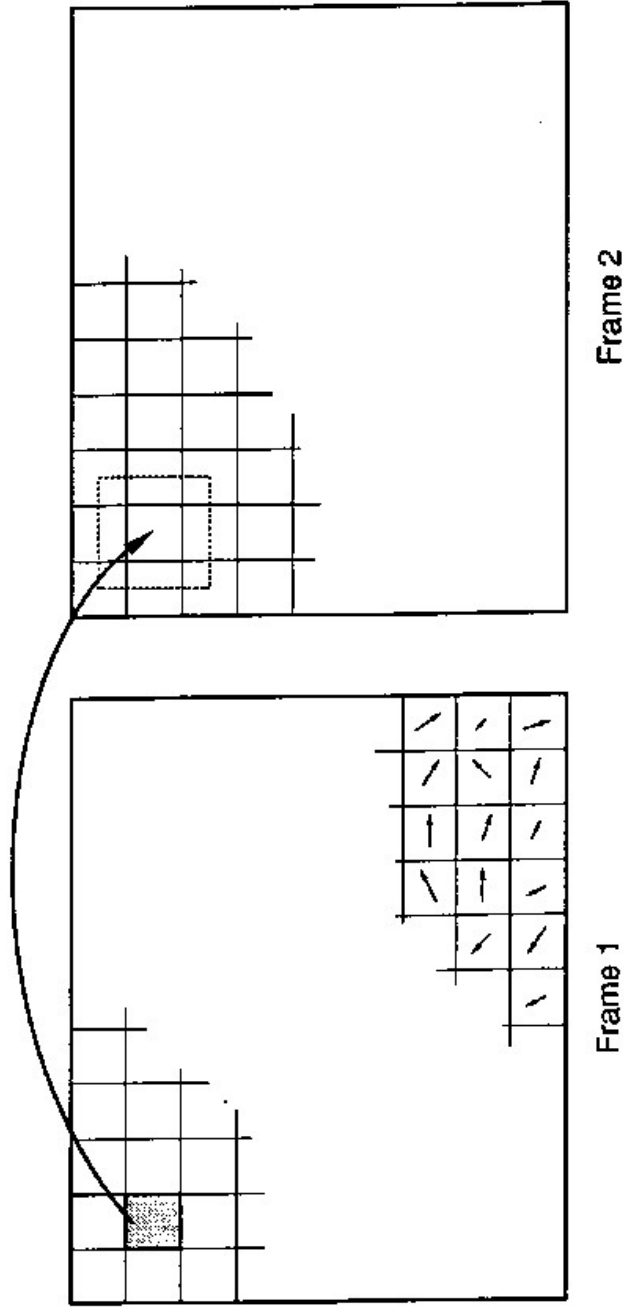


Original Image



Transmitted Image

**Objective:** Use "smart" sensing to locate image regions of significance for transmission through limited bandwidth channels.



Block matching approach to motion analysis.

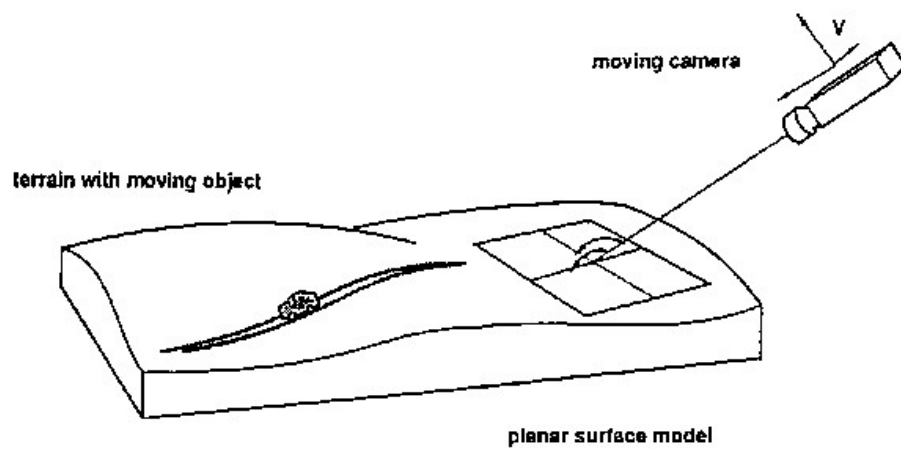


## Our Approach

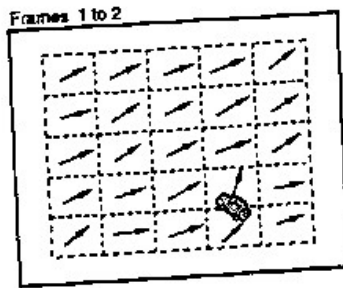


Pyramid-based, which results in:

- \* High quality conversion
- \* Real-time conversion
- \* Simple compact hardware

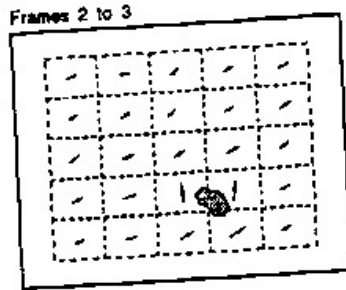


Detecting moving objects with a moving camera

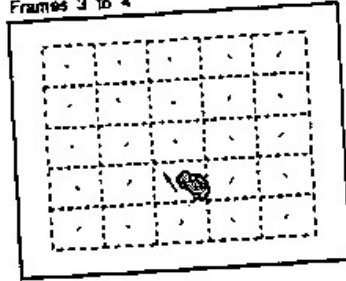


$V_{t-1}$

$\Delta V_t$

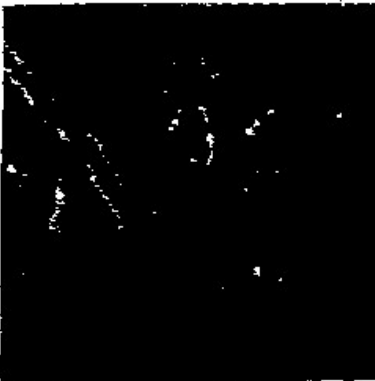


Frames 3 to 4

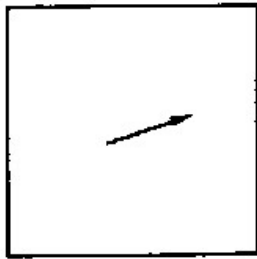


Rapid, Precise, motion determination through successive refinements

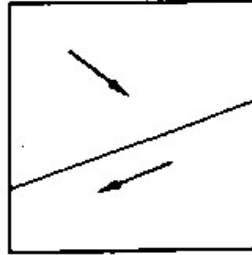
## Target Detection with a Moving Camera



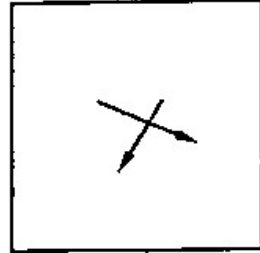




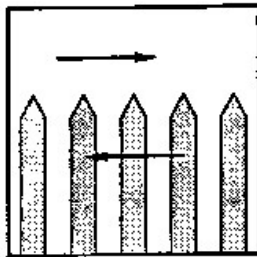
a



b



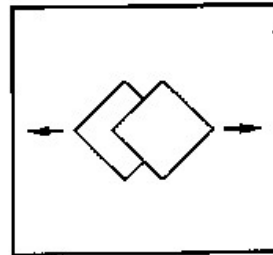
c



d



e



f

Elementary motion configurations.



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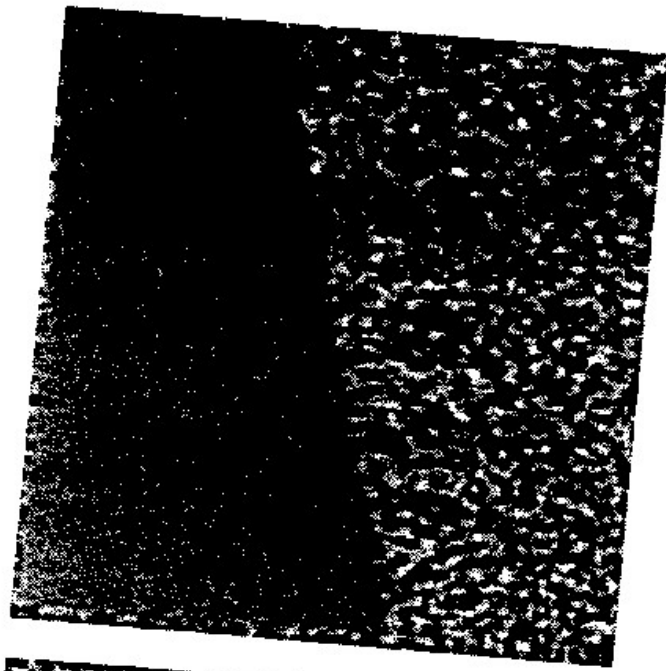
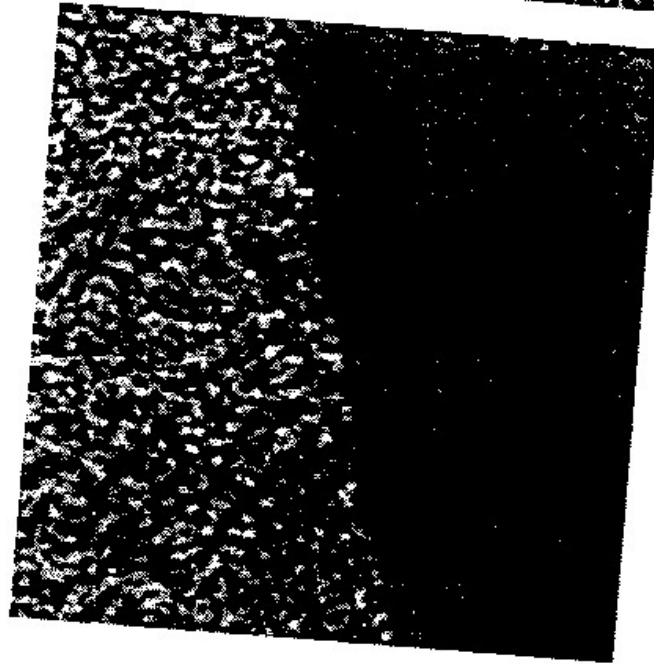
# Optical Flow Compensated Difference



*Company Private*

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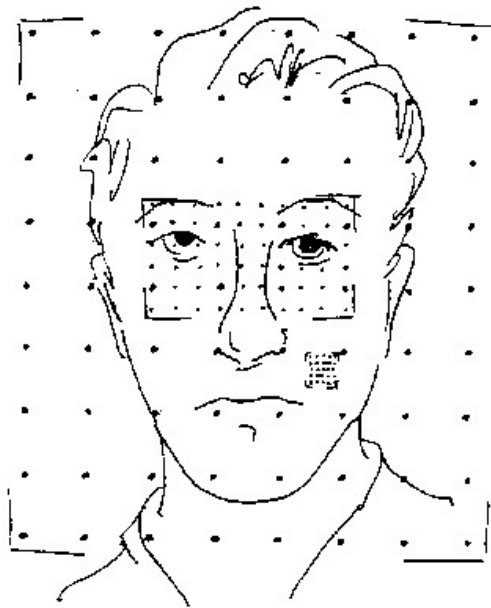
# "Two Motions" Compensated Differences



*Company Private*

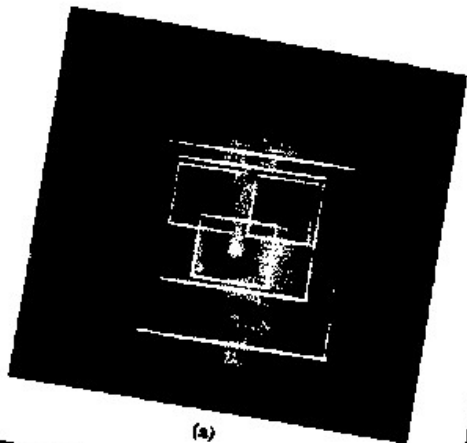
## MULTIRESOLUTION MECHANISMS IN MOTION

- size of region
- coarse-fine registration
- separation of motion components

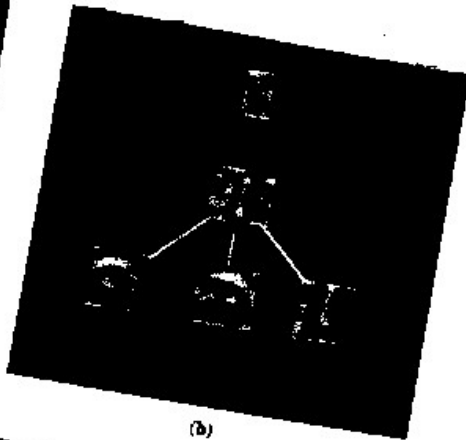


Face recognition through structured search for distinctive features over multiple resolutions

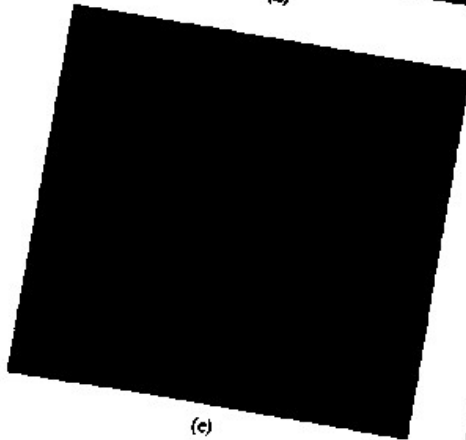
# Face Recognition



(a)



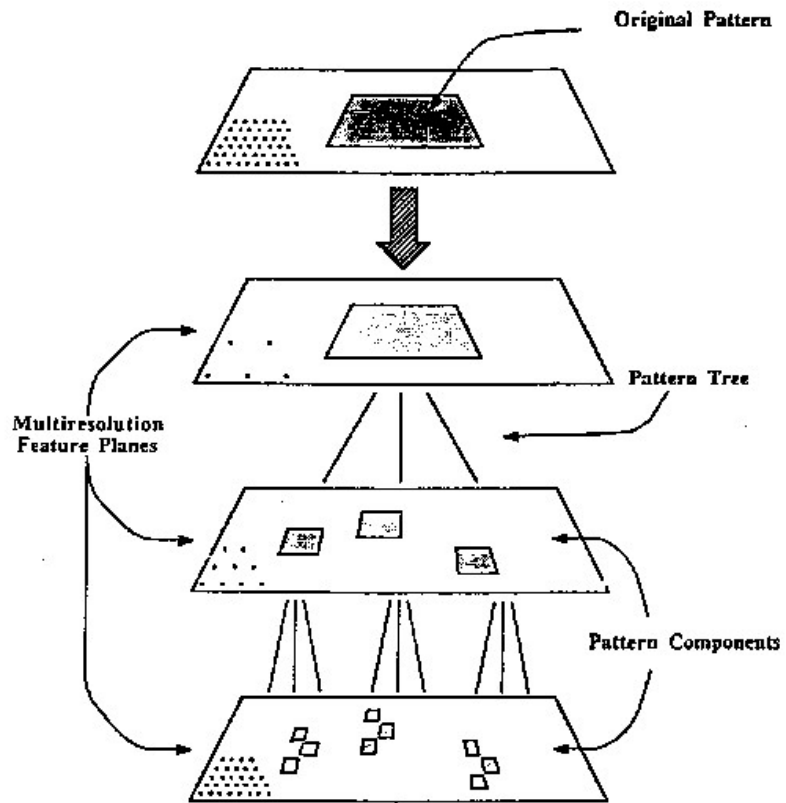
(b)



(c)



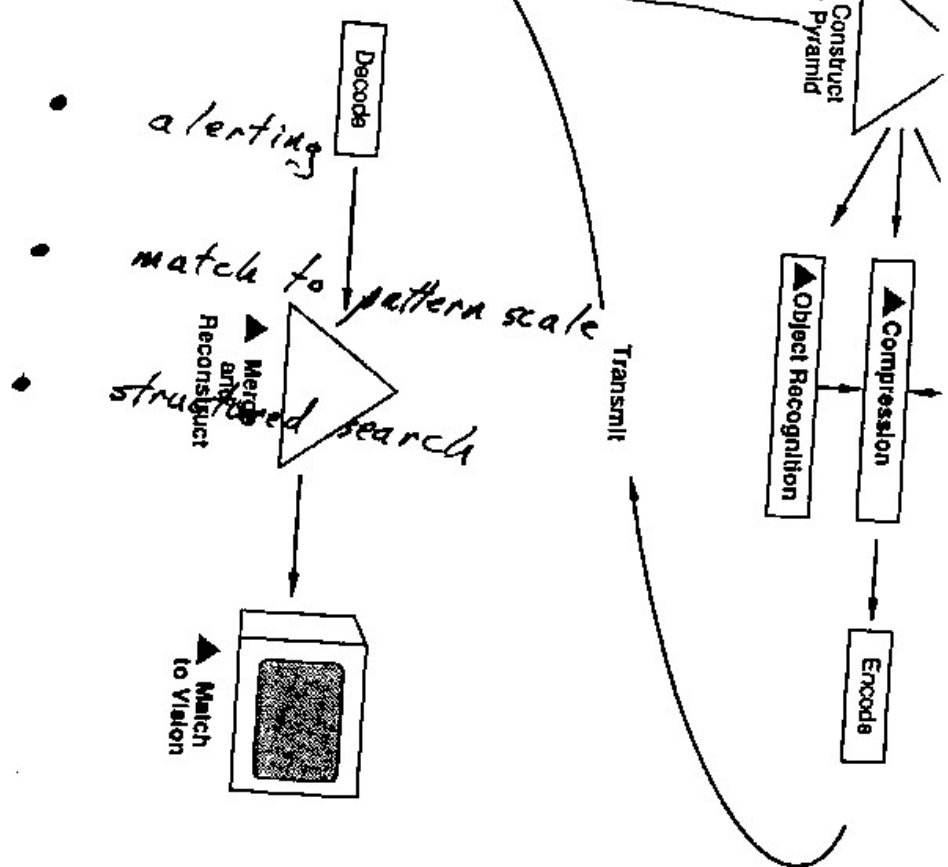
(d)



Pattern tree: An object pattern is decomposed into a set of distinctive component patterns that are linked over scales in a tree structure



# MULTIRESOLUTION MECHANISMS IN OBJECT REC.



- alerting
- match to pattern scale
- structured search

# Smart Transmission

